EXTENSION OF WALK-UP APARTMENTS

Alberta
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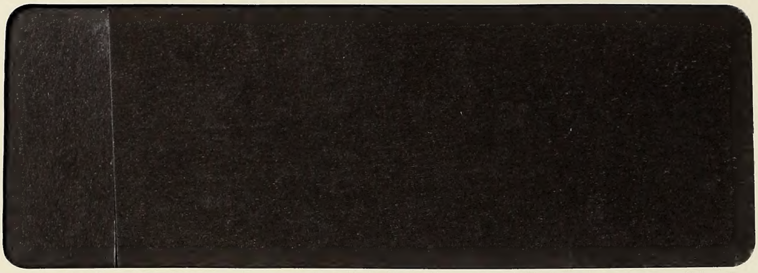
Innovative Housing Grants Program



EXTENSION OF WALK-UP APARTMENTS

MAY 1991

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With funding provided by
Alberta Municipal Affairs

ISBN: 0-88654-327-4

FOREWORD

The project documented in this report received funding under the Innovative Housing Grants Program of Alberta Municipal Affairs. The Innovative Housing Grants Program is intended to encourage and assist housing research and development which will reduce housing costs, improve the quality and performance of dwelling units and subdivisions, or increase the long term viability and competitiveness of Alberta's housing industry.

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As the type of project and level of resources vary from applicant to applicant, the resulting documents are also varied. Comments and suggestions on this report are welcome. Please send comments or requests for further information to:

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EXECUTIVE SUMMARY

The objective of this project was to examine the feasibility of adding a storey to existing 2½ storey walk-up apartment buildings to create 3½ storey wood framed walk-ups in accordance with the current Alberta Building Code and local Land Use By-Laws. The purpose of such extensions would be to increase the stock of rental housing in built up areas of major urban centres. This report is intended as a guide to prospective users in establishing a program for considering, planning and evaluating the viability of extending an existing building. It is not to be considered as a set of construction documents for the completion of such projects. Rather it is an introduction to the concept and an illustration of the various key issues. Competent professional advice must be obtained for the detailed planning and implementation of any project.

The study included an examination of existing buildings and their plans, a review of codes and land use by-laws governing the construction of such buildings, and a study of the technical feasibility of extending different types of buildings. Current economic conditions were assessed to establish the financial feasibility of such projects under existing market conditions, and to establish a range of rents, mortgage rates and construction costs which would give an adequate return on the invested capital.

Key issues in the study were land use and parking requirements and the economic factors influencing apartment construction in Alberta at this time.

The principal findings were as follows:

1. The possibility of expanding existing 2½ storey walk-up apartment buildings will be influenced by current code requirements and land use by-laws. In particular, prevailing parking requirements in major cities could hamper the exploitation of some sites to their fullest potential.

2. The technical problems in expanding such buildings vary with the type of building, but can be overcome in most cases. The main problem is to establish the existing conditions accurately.

3. The cost of such projects will be much more variable than that of new construction, due to the great variety of existing site and building conditions.

4. Economic conditions in Alberta from 1983 to the present time have not permitted any significant apartment construction. However falling vacancy rates and anticipated population growth in the province will tend to raise rents to a level at which this type of expansion can become economically feasible.

The study concludes that upward expansion of 2½ storey buildings would allow owners to maximize the developable potential of their existing land holdings. It would make additional rental accommodation available in established areas, close to existing services and amenities.

Conformance to land use and parking requirements constitute the principal planning problems that must be overcome.

In Edmonton, a current impediment to implementation of this concept is the low level of apartment rents currently being charged in the metropolitan area. With rents averaging about $180 per month below what would have to be charged to cover any new construction, the proposed extensions are not feasible. However, recent rent increases suggest that revenue levels will approach an economic threshold at which time this type of construction will be feaasible.

1.0 INTRODUCTION

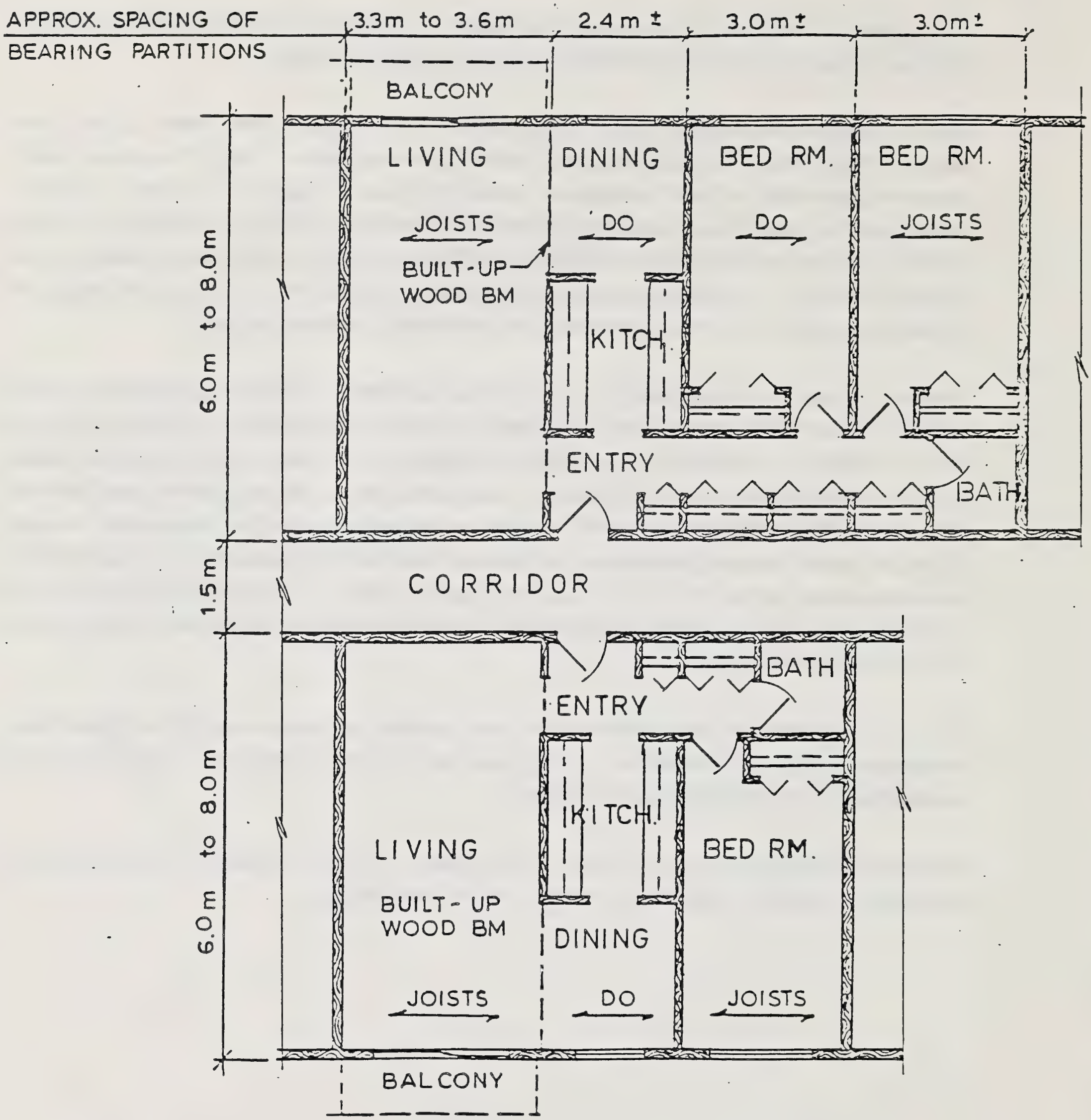
The purpose of this project was to explore the planning, technical and economic feasibility of adding a storey to existing 2½ storey, wood-frame, walk-up apartment buildings.

Built in considerable numbers from the early sixties to the mid-seventies, these buildings have afforded many Albertans good, reasonably priced accommodation. Typical 2-bedroom and 3-bedroom apartments in these buildings are shown in Figure 1 (Page 2). However, changes to various planning regulations eventually permitted the introduction of 3½ storey buildings. As a result of these changes, many owners find that their buidlings are only providing three-quarters of their potential income. The project explored this situation, and this report outlines the steps and decisions an owner must make preparatory to undertaking a building extension.

The work focused on wood-framed 2½ storey walk-up apartments, but can be applied to any similar structure on land that has not been developed to its maximum potential. The main body of the report, Chapter 2 is divided into five sections dealing with planning matters, structural issues, services, existing units and tenant protection. The chapter closes with an economic analysis of an extension to the example structure which is used as the basis for all of the discussions. In order to help the reader replicate the analysis for their own situation, the discussions are presented in a semi-instructional format which can be used as a project guide. This instructional format is most obvious in the economic analysis section where the various tables are provided with a blank column for use in an actual situation.

There is little if any information available from other sources that can be used in this type of work; consequently, each project will and in fact must be a unique investigation responding to the peculiarities of the individual site and building.

By following the logical process outlined in this report, an owner or developer should be able to analyze and evaluate the expansion potential of their own holdings.



FLOOR PLAN

TYPICAL 2 & 1 BEDROOM UNITS

FIGURE #1

2.0 STEPS IN PLANNING THE EXTENSION OF EXISTING WALK-UP APARTMENTS

This section is set up as a manual on how to investigate the principal problems in undertaking an extension of an existing 2½ storey apartment building. These problems were identified in the introduction.

A review of the drawings of various existing buildings made it obvious that much of the technical information required to plan for an expansion is not typically available on the documents and would have to be obtained on site. A step-by-step review was therefore adopted to identify existing conditions and to develop strategies for the most logical solutions in planning the extension. Some attention was also given to upgrading existing units in conjunction with a proposed expansion. This could make the project more acceptable to the planning authorities especially if variances are requested, and the upgrades would present an opportunity to increase rents.

2.1 REVIEW OF BUILDING CODE AND PLANNING REQUIREMENTS

At the time of writing, additions to existing buildings are required to conform to the provisions of the Alberta Building Code 1985 [Code reference 1.2.1]. The 1990 Code, due to be adopted soon, will change some requirements, which will be helpful in the planning process in many cases.

The provisions having the greatest impact on any proposed addition of the type considered in this study are contained in Part 3, Use and Occupancy. Code reference 3.2.2.27 gives the maximum permissible areas and fire resistance requirements for wood frame apartments up to 3 storeys in height. For unsprinklered buildings the maximum areas of the largest floor or building footprint are:

	ONE-STOREY	TWO-STOREY	THREE-STOREY
Facing 1 Street	$1200m^2$	$900m^2$	$600m^2$
Facing 2 Streets	$1500m^2$	$1125m^2$	$750m^2$
Facing 3 Streets	$1800m^2$	$1350m^2$	$900m^2$

It should be noted that for the purpose of computing the maximum permissible areas a standard 6.1 m (20 ft) lane is not considered to be a street in the 1985 Alberta Building Code.

To review the likelihood of an existing building conforming to these requirements, the code in effect at its time of construction should be known. The Alberta Building Code was adopted throughout the province in April 1974, the first edition being based on the 1970 National Building Code. Prior to that date various codes were in use in individual municipalities. In the City of Edmonton, for example, the West Coast Uniform Building Code was used from 1960 to March 1968, the 1965 National Building Code from April 1968 to May 1973, and the 1970 National Building Code from June 1973 to April 1974. The 1965 National Building Code was more restrictive than the 1985 code. The maximum permitted areas were generally lower for one and two storey buildings. The 1970 National Building Code was similar to the 1985 code.

Buildings that exceed the maximum permissible areas for 3 storeys (unless subdivided by fire walls into the appropriate areas) would require the addition of sprinklers throughout the building to qualify for expansion. It is unlikely that this would be a cost effective solution and a further analysis appears unnecessary in this case.

The code revision to be adopted in 1991 allows an access route or lane to be considered as a street for building classification. It also allows an increase in maximum building areas of about 33% for residential buildings up to 3 storeys where a minimum 1 hour fire rating is provided for floors, roofs and load-bearing assemblies. As the difference between a 45 min. and 1 hour fire rating is a relatively small increase in the drywall thickness protecting bearing walls and ceilings it would be worthwhile to establish whether an existing building qualifies for a 1 hour rating. The combination of these two factors can result in a significant increase in maximum building areas for three storey buildings over those permitted in the 1985 Code.

PLANNING AND LAND USE ISSUES - CITY OF EDMONTON

The City of Edmonton Land Use By-Law (1987) was reviewed, and discussed with planning officials to identify the problems most likely to be encountered in planning the proposed extensions. Planning regulations have changed significantly since the majority of the existing units were built. As a result most do not conform to some requirements of the current by-law. The most important items for consideration are:

.1 Parking:

Most buildings were constructed under a previous by-law that required one parking stall per apartment unit, and already tend to barely meet that requirement. In the central areas of the city the entire rear of the property is generally used to provide the minimum number of required stalls (Plates 2, 3, 7, 8, 9 and 10 - See Appendix). Present requirements require

1 stall per bachelor or 1 bedroom apartment, 1.5 stalls per 2 bedroom apartment and 1.75 stalls per 3 bedroom apartment. Existing buildings therefore are likely to need 25% to 30% more parking spaces to meet the requirements of their present units. Parking for any addition would be an additional requirement.

The current by-law also requires landscaping of parking areas for more than 50 cars and screen planting around areas for more than 8 cars. Plates 2, 9 and 10 (See Appendix) show no landscaping at parking areas in central district, Plates 14 and 16 (See Appendix) indicate some landscaping in the outer district. Plates 17, 18 and 19 (See Appendix) show integrated landscaping and parking in a multi-building project.

.2 Maximum Density and Site Coverage:

Current requirements are somewhat less restrictive than those of the previous by-law. Areas previously classified as R3 and R4 are now RA7, previous classification R5 is now RA8. In each case higher densities are possible where a building contains a significant number of 2 bedroom units. The largest increase is available where the classification has changed from R3 to RA7.

.3 Height Restrictions, Front, Rear and Sideyards:

There has been relatively little change in these requirements. The maximum height permitted by RA7 zoning is 14 m or 4 storeys, RA8 permits a height of 23 m or 6 storeys, but this report will focus on 3½ storey wood frame buildings even in these areas. Minimum front and rear yards are virtually unchanged from previous requirements. Minimum side yards are somewhat greater for RA8 zoning than for the previous R5 zoning (see Table 1, Page 6). This could be a factor in central areas (Plates 5 and 6 - See Appendix).

.4 Amenity Areas:

The current by-law requires the provision of 7.5 m^2 of amenity area per dwelling unit. No such requirement existed previously. Amenity areas may include balconies with a minimum depth of 2 m, roof terraces and indoor or outdoor recreation facilities.

Table 1 (Page 6) is a comparison of some of the principal requirements of the 1973 R4 and R5 and the 1987 RA7 and RA8 classifications of the Edmonton Land Use By-Law.

TABLE 1 : COMPARISON OF 1973 TO 1987 REQUIREMENTS EDMONTON LAND-USE BY-LAW

	1973 R4	1987 RA7	1973 R5	1987 RA8
PARKING	1 per dwelling unit	1 per bach or 1 bedroom 1.5 per 2 bedroom 1.75 per 3 bedroom	1 per dwelling unit	1 per bach or 1 bedroom 1.5 per 2 bedroom 1.75 per 3 bedroom
MAXIMUM DENSITY	750 ft^2 per bachelor 1000 ft^2 per 1 bedroom 1350 ft^2 per 1 bedroom	125 per Ha = 80 m^2 per unit = 861 ft^2 per unit	450 ft^2 per bachelor 600 ft^2 per 1 bedroom 850 ft^2 per 2 bedroom Sites $\ngtr$ 9500 ft	224 per Ha = 44.64 m^2/unit = 480.5 ft^2/unit Sites $\ngtr$ 885 m^2 (9526ft^2)
MAXIMUM FLOOR AREA OR SITE COVERAGE	35% site cover	Floor Area Ratio 1.3 (32.5% 4 storeys)	40% site cover	Floor Area Ratio 1.5 (37.5% 4 storeys)
MAXIMUM HEIGHT	45 ft or 4 storeys	14 m (45.9 ft) or 4 storeys	75 ft or 6 storeys	23 m (75.5 ft) or 6 storeys
MINIMUM FRONT YARD	$\nless$ 20 ft. $\ngtr$ 35% of Lot Depth	6 m (19.7 ft)	$\nless$ 20 ft	6 m (19.7 ft)
MINIMUM REAR YARD	25 ft	7.5 m (24.6 ft)	25 ft	7.5 m (24.6 ft)
MINIMUM SIDE YARD	$\nless$ 10% of width $\ngtr$ 7 ft under 25 ft high $\nless$ 20% of width $\ngtr$ 15 ft over 25 ft high 15 ft at side str.	1 m (3.3 ft) per storey or partial storey $\nless$ 2 m 4.5 m (14.8 ft) at side str	walls without windows $\nless$ 5 ft for 2 storeys 5 ft + 1 per storey over 2 storeys	1 m (3.3 ft) per storey or partial storey $\nless$ 2 m $\ngtr$ 4.5 m
AMENITY AREA (MAY INCLUDE BALCONIES 2M WIDE)		7.5 m^2 per unit		7.5 m^2 per unit

RA7 = R3 & R4 RA8 = R5 & R3A

From the above it is apparent that parking requirements would be the greatest single factor restricting the application of the proposed extension program. For a 33% increase in the number of units some 66% more parking stalls are required in most cases to meet current standards. In some circumstances the number of parking stalls may be reduced on the basis of a demand study to be submitted to the development officer, but may not be less than one per unit. Further by-law relaxations would have to be negotiated with municipal authorities on the basis of the need for additional housing in core areas.

PLANNING AND LAND USE REQUIREMENTS - OTHER CITIES

The planning departments in Calgary, Medicine Hat, Lloydminster, Red Deer, Lethbridge and Camrose were contacted to compare potential planning problems in those cities with those in the City of Edmonton.

Calgary's Land Use By-Law differs significantly from Edmonton's. Parking requirements are somewhat less severe, averaging 1 stall per unit, depending on the building's size and location. The study did not establish to what extent existing buildings meet this requirement. Landscaping requirements restrict the site area available for surface parking. Land Use classifications for existing 2½ storey apartment buildings would include districts zoned RM-4 to RM-7. Forty percent of the site area is required to be landscaped in these districts, necessitating the provision of underground parking in higher density areas. RM-4 districts limit building height to 3 storeys or 9 m at an eave line making them unsuitable for this type of expansion. RM-5 districts permit a maximum of 4 storeys or 12 m at any eave line. Amenity space requirements are similar to Edmonton's.

Medicine Hat has more severe parking requirements at present than 15 to 20 years ago. These would be the principal obstacle in planning for expansion.

Lloydminster and Red Deer both noted that their existing buildings have already been developed to the maximum permissible density; consequently these areas are not suitable for potential expansion programs. Lethbridge and Camrose do not appear to have a significant number of buildings of this type and were therefore not considered in the planning process.

REVIEW OF ZONING REQUIREMENTS

Unlike building codes which are uniform throughout the province, land use by-laws vary from municipality to municipality. As is the case with the building code, land use by-laws have been changed in the time that many of the buildings under consideration have existed. Current requirements may make an addition easier or more difficult depending on the location and zoning of the building under consideration.

In the City of Edmonton, for example, district classifications have changed from the 1973 land use by-law (under which most of the buildings of this type were built) to the 1987 by-law in force at present. A sample calculation of the permissible maximum building areas and maximum number of units would be as follows:

1973 CLASSIFICATION R5	FT^2	M^2
Site (150 ft x 150 ft/45.7 m x 45.7 m)	22,500	2,090
Existing Building Area Per Floor	8,960	832

Total Number of Existing Apartments	:	30 (18 - 2 Bedroom; 11 - 1 Bedroom; 1 - Bachelor)
Required Site Area	:	18 x 850 + 11 x 600 + 450 = 22,350 ft^2
Maximum Site Coverage	:	40% = 9,000 ft^2

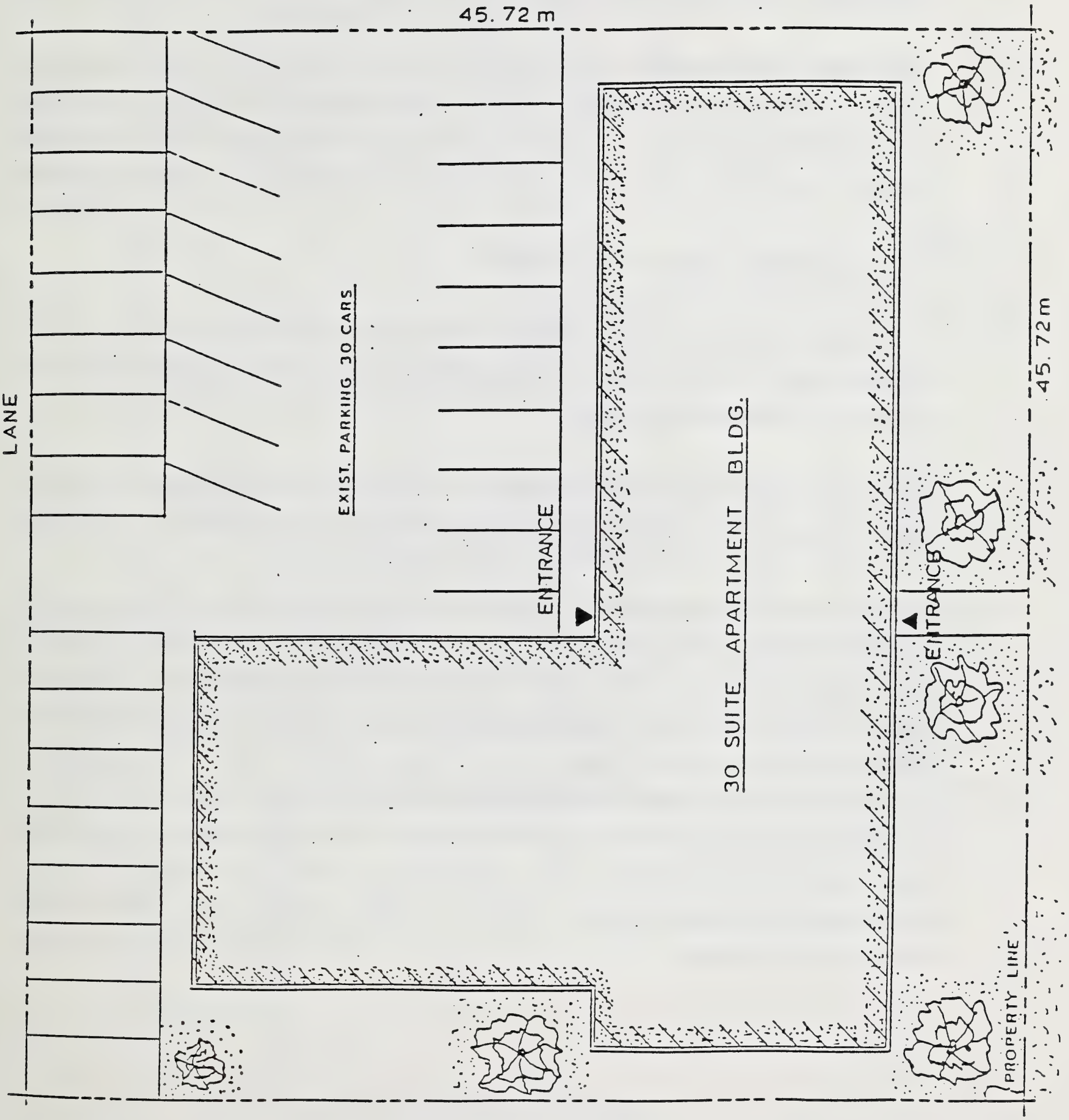
1987 CLASSIFICATION RA8	FT^2	M^2
Maximum Total Building Area (1.5 x site)	33,750	3,135
Existing Building Area (3 x 8,960)	26,880	2,497
Additional Building Area Available	6,870	638

Maximum Number of Permitted Dwellings	:	224 x 0.209 = 46
Proposed Number of Additional Units	:	7 (4 - 2 Bedroom, 3 - 1 Bedroom)
Total New Units	:	7
Total Units After Addition	:	37

REVIEW OF PARKING REQUIREMENTS

Requirements for parking have changed with the land use by-laws of which they form a part. In many cases they have become more restrictive, and may be one of the principal obstacles in planning a building expansion. For example, the 1973 City of Edmonton by-law required 1 parking space per dwelling unit, while the 1987 by-law requires 1 space per bachelor or 1 bedroom unit, 1.5 spaces per 2 bedroom unit and 1.75 spaces per 3 bedroom unit. Most existing buildings will therefore fall short of current parking requirements. The proposed addition would require 1.5 x 4 (2 bedroom) + 1.0 x 3 (1 bedroom) = 9 new parking stalls of its own.

In the example discussed above, 30 parking spaces were originally provided (Figure 2 Page 9). To meet current by-law requirements (18 x 1.5 + 12 x 1) or 39 spaces would be required. With 9 additional spaces for the extension a total of 48 spaces would now be required. As noted above in some circumstances the minimum number of parking stalls could be reduced but may not be less than one per unit.



TYPICAL APARTMENT BUILDING
SITE PLAN

FIGURE # 2

Many existing sites cannot accommodate any more parking at grade. On some sites it will be feasible to construct simple 2 level parking structures as illustrated in Figure 3 (Page 11). In the given example even this does not fully meet the present requirements of 48 spaces but the ratio of spaces provided to spaces required (43/48) is significantly better than the current ratio (30/39) and can form the basis for discussion of relaxations with the local authorities.

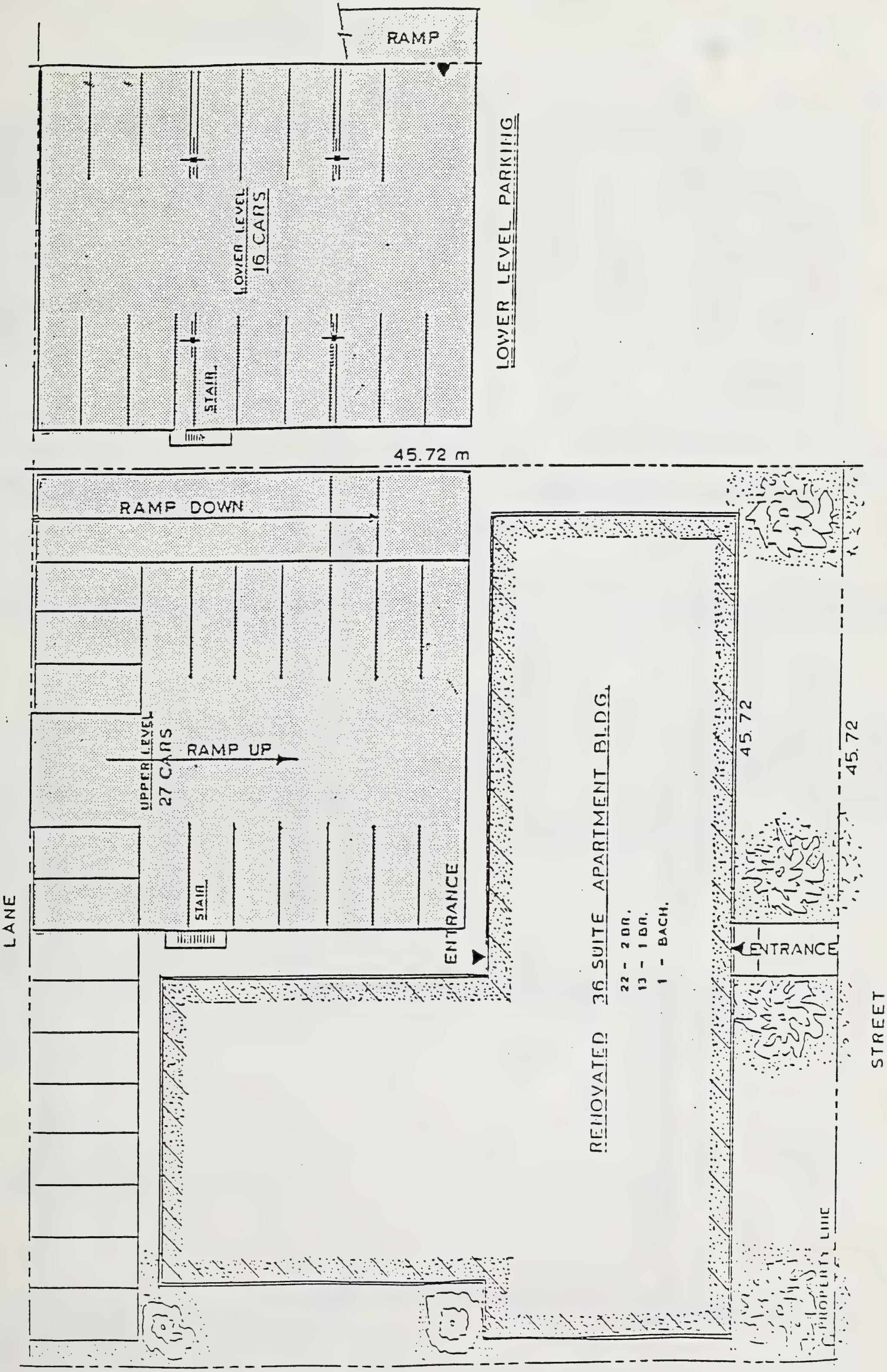
In some cases it will be possible to acquire additional property. The addition of a 50 ft x 150 ft (15.2 m x 45.7 m) lot to the previous example is shown in Figure 4 (Page 12). In this case, the full area of the existing building can be used for expansion, resulting in 40 units, and the full required parking can be accommodated at grade. Even when the additional property is not contiguous with the property in question, its use may be acceptable to the planning authorities and merits discussion.

REVIEW OF AMENITY SPACE REQUIREMENTS

Amenity spaces may be required for residential buildings under current land use by-laws. For the project under consideration 7.5 m^2 of amenity space area are required per unit under the 1987 Edmonton By-Law. This requirement did not exist in the 1973 by-law and may form the basis for discussion of a relaxation in this aspect.

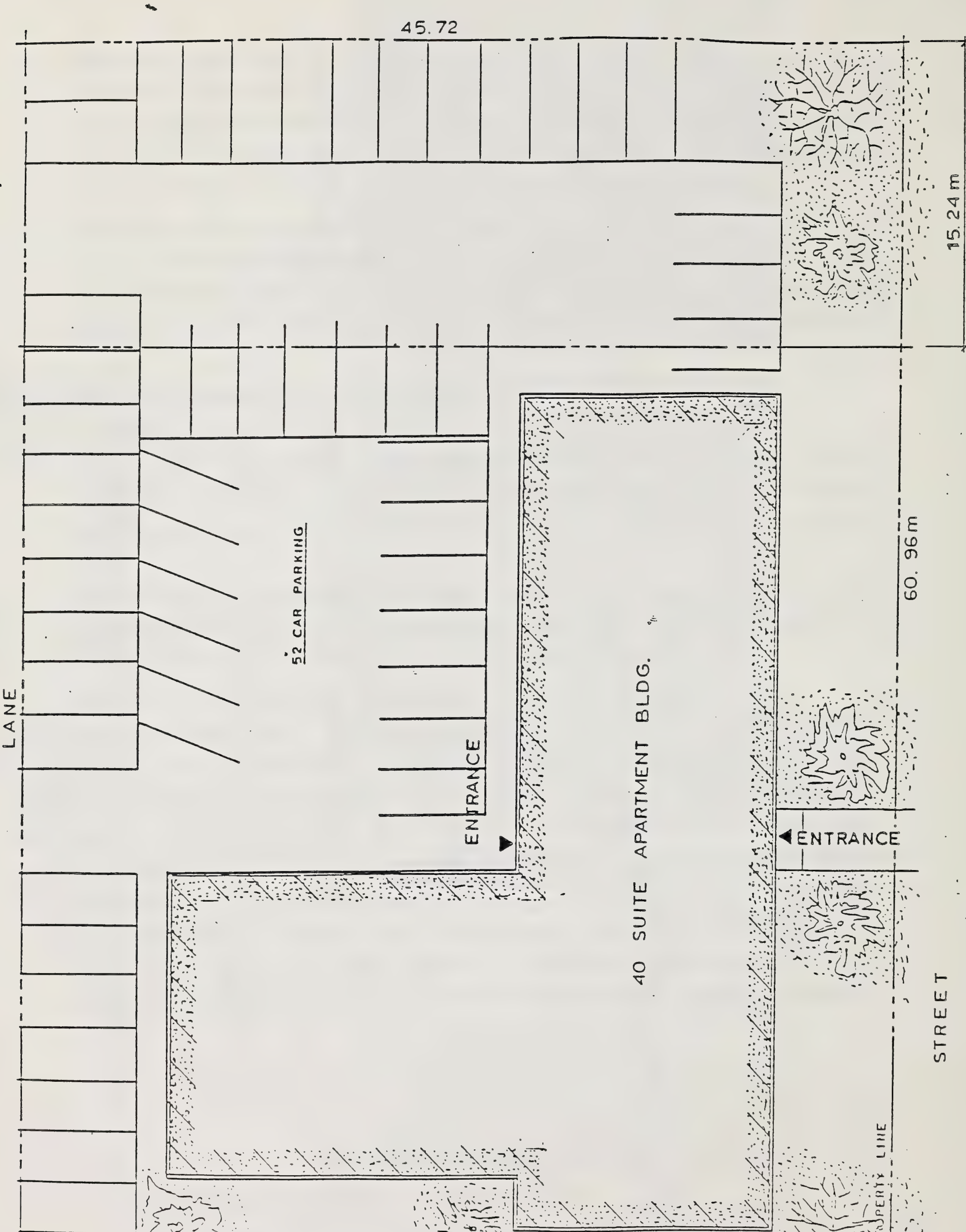
Amenity areas, in this case, may consist of patios or balconies with a minimum depth of 2 meters, roof terraces, communal lounges and recreational facilities, or other areas within the site for the active or passive recreation and enjoyment of the occupants.

Where only a portion of the existing roof can be used for the added floor, the remainder can be developed as amenity space. Alternatively, amenity space could be developed on the roof of the extension in which case there would be ample area to meet the by-law requirements. In the case of the building expanded from 30 units to 37 units Figure 3 (Page 11) about 190 m^2 of the roof area remain for use as amenity space. The total area required in this instance is 37 x 7.5 = 277.5 m^2. Existing balconies are generally not wide enough to qualify as amenity areas, but can be widened by the addition of simple exterior columns Figure 5 (Page 13). Such columns would also be convenient supports for the balconies of the additional floor. This is an expensive option and should only be considered as a last resort. With 7 new balconies at least 7.5 m^2 in size and the roof amenity area of 190 m^2, the complex is only 35 m^2 deficient in amenity area. This is a vast improvement over the existing condition and as such is a strong basis for discussion of relaxation of this land use requirement.



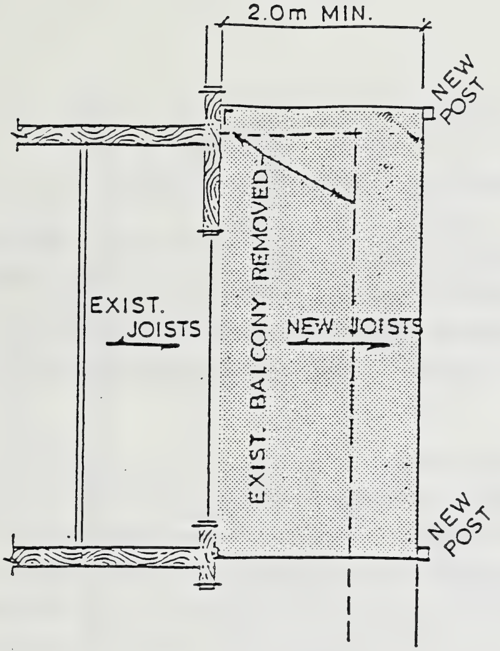
SITE PLAN with 2 LEVEL PARKING PARKADE

FIGURE # 3

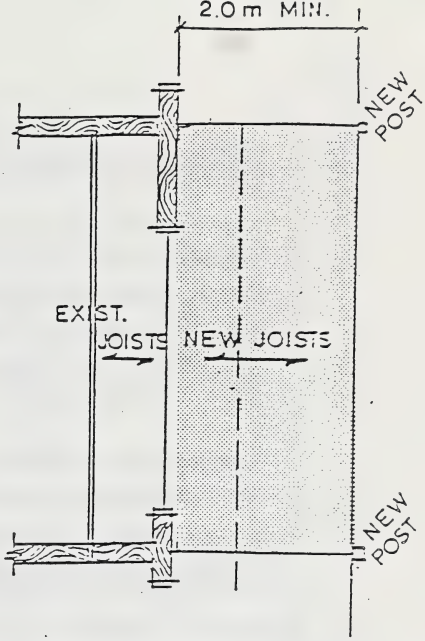


SITE PLAN with ADDITIONAL LOT

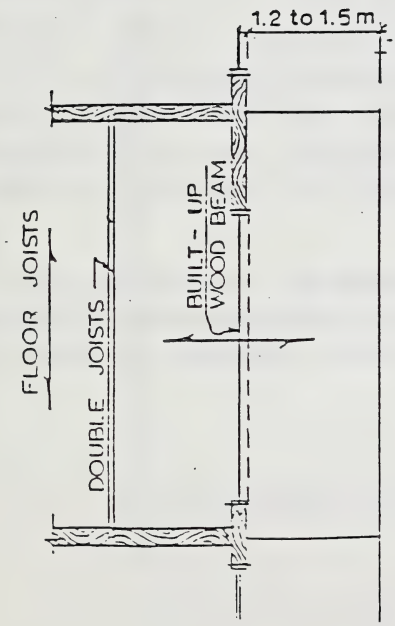
FIGURE # 4



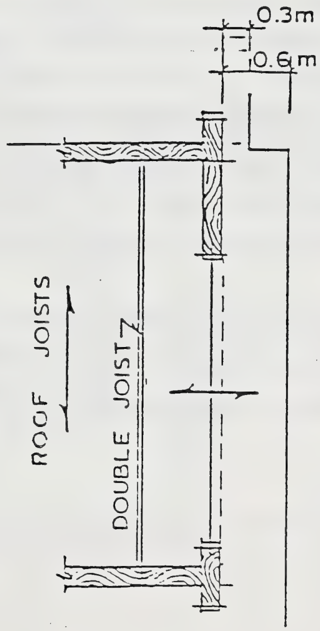
AMENITY AREA BALCONY FRAMING
EXISTING FLOORS



AMENITY AREA BALCONY FRAMING
NEW FLOOR



EXIST. BALCONY FRAMING



EXISTING ROOF OVERHANG

AMENITY AREA and BALCONIES

FIGURE #5

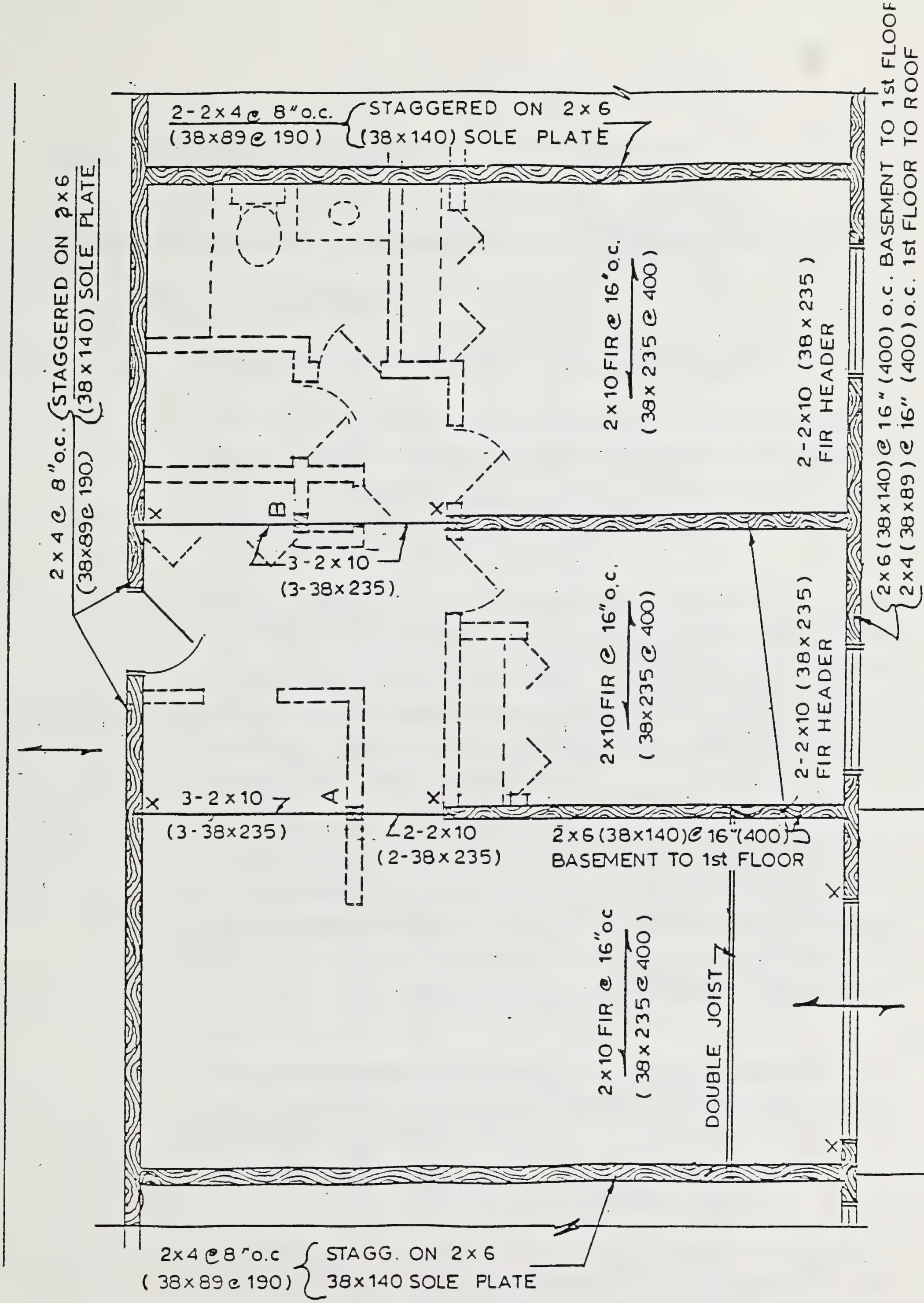
2.2 REVIEW OF EXISTING STRUCTURE

The review of the existing structure should concentrate on finding the most efficient way of carrying the additional floor and roof loads to the foundations and bearing material. While it should be a relatively simple procedure to calculate the load carrying capacities of existing bearing walls and footings, it is unlikely that drawings, where they exist, will contain enough information to allow this to be done with any degree of certainty, nor can it be assumed that such drawings accurately represent as-built conditions.

A typical apartment layout is shown in Figure 6 (Page 15) with the framing and partition details that could be obtained from the existing drawings. Joists were identified only as "Fir" with no stipulation of species or grade. Studs for bearing partitions were identified neither by species nor grade, and no mention was made of the material of the top and bottom plates. As the load bearing capacity of the partitions is governed by the capacity of both the studs and the plates, this information is essential. Concentrated loads at the ends of built-up beams require particular attention. At points A and B on Figure 6 (Page 15) hatching was used to indicate posts, but the number of studs at each level was not given on the drawings. Built-up posts would also be required at locations marked X, but there was no information as to their existence.

Information that is not available on the drawings must be obtained on-site. This could require the removal of existing finishes in critical areas to observe actual details of construction. Where grade stamps can be found on existing members, the date of construction is significant in assigning permissible stresses to them. Both timber design codes and grading rules have changed substantially over the past 30 years. Table 2 (Page 16) shows some of the more important changes in species and grade classifications and permissible stresses that have occurred in this period. CAN3-086.1-M89, the latest standard for engineering design in wood, is based entirely on limit states design and is not directly comparable.

Foundation loads due to this type of construction are relatively light, and strip footings are likely to be of the minimum practical dimensions. In the absence of detailed soils information a knowledge of local conditions is required to make a reasonable assessment of soil bearing capacities and the ability of existing footings to support additional loads.



TYPICAL APARTMENT FRAMING PLAN

1. BEARING WALLS SHOWN SOLID
2. NON BEARING WALLS SHOWN DOTTED
3. TYPICAL INTERIOR FOOTING 20"x 10"(500x250) DEEP
4. EXTERIOR WALL FOOTING 18 x 9 (450x 225) DEEP

FIGURE # 6

TABLE # 2 CHANGES IN WORKING STRESS DESIGN (SAWN LUMBER)

1960 – 1985 C.S.A. CODES

CSA 086 - 1959

SPECIES OR GROUP	GRADE	BENDING p.s.i. (MPa)	SHEAR psi (MPa)	COMP. PERP. TO GRAIN psi (MPa)	COMP. PARAL TO GRAIN psi (MPa)	E psi (MPa)
Ib DOUGLAS FIR WESTERN LARCH	SELECT STRUCT.	1 900 (13.1)	120 (0.83)	415 (2.86)	1 500 (10.3)	1.6×10^6 (11 000)
	CONST.	1 500 (10.3)	120 (0.83)	415 (2.86)	1 200 (8.3)	1.6×10^6 (11 000)
	STAND.	1 200 (8.3)	95 (0.66)	390 (2.69)	1 000 (6.9)	1.6×10^6 (11 000)
III SPRUCE (all) FIR-3SPEC, PI 3SPEC.	SELECT STRUCT.	1 300 (9.0)	90 (0.62)	300 (2.07)	900 (6.2)	1.1×10^6 (7 600)
	STRUCT.	1 050 (7.2)	90 (0.62)	300 (2.07)	750 (5.2)	1.1×10^6 (7600)
	CONST. OR No 1	840 (5.8)	70 (0.62)	300 (2.07)	600 (4.1)	1.1×10^6 (7600)
MODIFICATION FACTORS	K_D (2 MTHS)	1.15	1.15	1.15	1.15	1.0
	K_S (WET)	0.90	1.0	0.67	0.90	1.0
	K_T (TREAT)	1.0	1.0	1.0	1.0	1.0
	K_H (LD SHAR)	1.1	1.1	1.1	1.1	1.0
	K_Z (SIZE)					

CSA 086 – 1970

SPECIES OR GROUP	GRADE	BENDING psi (MPa)	SHEAR psi (MPa)	COMP. PERP. TO GRAIN psi (MPa)	COMP. PARAL TO GRAIN psi (MPa)	E psi (MPa)
A DOUGLAS FIR WESTERN LARCH	SELECT STRUCT.	1 900 (13.1)	90 (0.62)	460 (3.17)	1 400 (9.7)	1.93×10^6 (13 300)
	No 1	1 600 (11.0)	90 (0.62)	460 (3.17)	1 250 (8.6)	1.93×10^6 (13 300)
	No 2	1 300 (9.0)	90 (0.62)	460 (3.17)	1 050 (7.2)	1.74×10^6 (12 000)
D SPRUCE (all) FIR-2SPEC, PINE-2SPEC.	SELECT STRUCT.	1 300 (9.0)	60 (0.41)	245 (1.69)	1 000 (6.9)	1.35×10^6 (9 300)
	No 1	1 100 (7.6)	60 (0.41)	245 (1.69)	900 (6.2)	1.35×10^6 (9 300)
	No 2	900 (6.2)	60 (0.41)	245 (1.69)	750 (5.2)	1.22×10^6 (8 400)
MODIFICATION FACTORS	K_D (2 MTHS)	1.15	1.15	1.15	1.15	1.0
	K_S (WET)	0.84	0.96	0.67	0.69	0.94
	K_T (TREAT)	0.9	0.9	0.9	0.9	1.0
	K_H (LD SHAR)	1.1	1.1	1.1	1.1	1.0
	K_Z (SIZE)					

CAN 3-086 - M84

SPECIES OR GROUP	GRADE	BENDING MPa.	SHEAR MPa.	COMP. PERP. TO GRAIN MPa.	COMP. PARAL TO GRAIN MPa.	E MPa.
DOUGLAS FIR-LARCH DOUGLAS FIR WESTERN LARCH	SELECT STRUCT.	9.8	0.62	3.17	9.7	12 600
	No 1	5.5	0.62	3.17	8.7	10 900
	No 2	5.5	0.62	3.17	7.3	10 900
SPRUCE-PINE-FIR SPRUCE (all ex. sitka) FIR-2SPEC, PINE-2SPEC.	SELECT STRUCT.	9.0	0.46	1.67	6.9	11 100
	No 1	6.5	0.46	1.67	6.2	10 200
	No 2	6.5	0.46	1.67	5.2	10 200
MODIFICATION FACTORS	K_D (2 MTHS)	1.15	1.15	1.15	1.15	1.0
	K_S (WET)	0.84	0.96	0.67	0.69	0.94
	K_T (TREAT)	0.7	0.7	0.7	0.7	0.9
	K_H (LD SHAR)	1.15	1.15	1.1	1.1	1.0
	K_Z (SIZE)	0.9 TO 1.5	1.0	1.0	1.0	1.0

SELECTION OF STRUCTURAL SYSTEMS

Selection of the most suitable framing system depends on the construction of the existing building. Buildings may be divided into two major categories, flat roofed buildings and pitched roof buildings.

.1 Category 1 - Flat Roofed Buildings:

a) Buildings with additional capacity in the existing bearing partitions.

As floor and roof live loads for this type of buildings are similar, many buildings were constructed with the same joist sizes and spacings in both the floors and roof. If the existing bearing partitions have the capacity to support the additional loads of the new floor and roof, the same type of construction may be used for the new roof framing with the old roof becoming the new third floor.

In Figure 6 (Page 15) for example, the bearing partitions may be able to support the added loads if the studs and plates are of Douglas Fir (Douglas Fir, Western Larch) construction. Built-up posts at locations marked A, B and X would have to be checked for number and capacity. If these posts are adequate to support the added loads, the roof framing could be essentially similar to the existing framing. However joist sizes and spacing and built-up beams must be designed in conformance with current code requirements.

Most old buildings were constructed with flat roofs for economy in framing. Today it is considered good roofing practice to slope nominally flat roofs a minimum of 2% towards the drains. Due to the areas and dimensions of most apartment buildings, considerable additional framing will be required to achieve such slopes. Although it is now possible to get sloped insulation, substantial thicknesses will be required. A trade-off, therefore, exists between the first cost of such framing or insulation and the life-cycle cost of the roofing materials.

Balconies at the existing roof/third floor level may require special framing. The addition of exterior posts would eliminate the need to review the existing framing inside the building (Figure 5, Page 13).

b) Buildings with no additional capacity in the existing bearing partitions:

If in the example above, the bearing partitions were constructed of spruce (S.P.F.) it is unlikely that the partitions inside the lower units could support the loads of an additional floor and new roof. It may also be found through the site investigation that the built-up posts at A and B have insufficient capacity for the added loads.

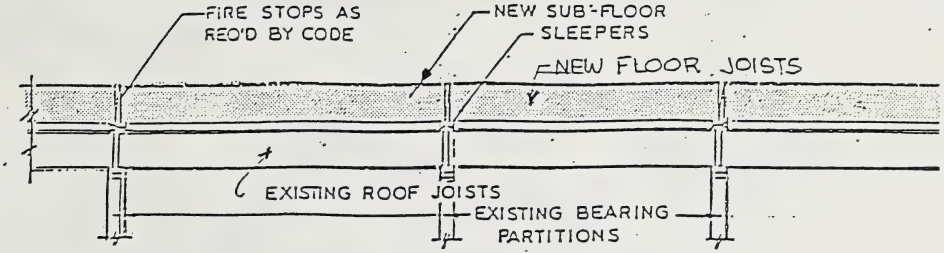
In this case, a choice would have to be made between reinforcing the existing posts or using a different roof framing system.

If the existing roof system is the same as the floor framing system, it should be capable of supporting a floor load. In this case, only the new roof would be required. The most logical framing system spans the roof joists from the exterior walls to the corridor walls. Both of these walls generally carry only light loads due to existing framing (Figure 6, Page 15) with the possible exception of concentrated loads particularly at the ends of built-up beams supporting balconies (locations X on Figure 6, Page 15). It is therefore likely that they will at least be able to support the loads of the new roof. However the resulting new roof spans are beyond the range of sawn timber joists. Fortunately there are a variety of wood trusses or built-up "I" members available from Alberta manufacturers which are suitable for the spans under consideration. Members with a depth of 400 to 500 mm (16 to 20 inches) would be required for the normal range of spans seen in this study. Trusses are available in a variety of configurations and can be obtained with sloping or pitched top chords to achieve adequate roof slopes.

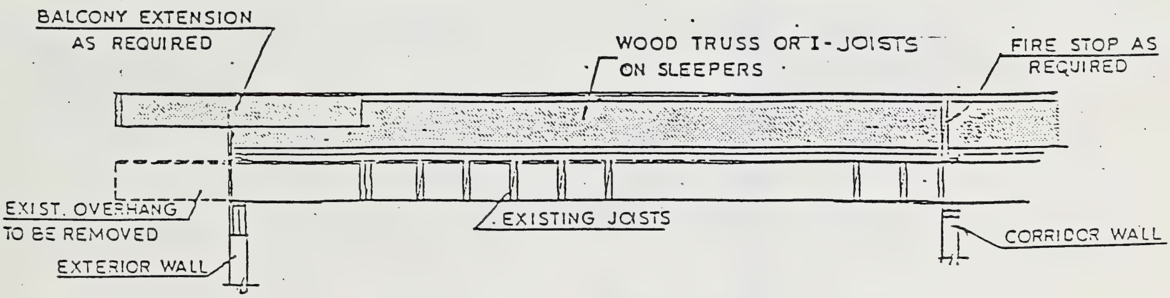
c) Buildings in which the existing roof joists cannot support a floor load:

In some cases the existing roof construction differs from the floor framing and cannot support the loads of the proposed floors. In this case, two possibilities exist for framing the floor. If the existing partitions are adequate (the load increase in this case is small), new joists can be placed over the existing roof parallel to the existing framing. This permits the use of sawn timber joist sizes and minimizes the increase in floor to floor height. Alternatively, the framing could be spanned in the opposite direction, resulting in depths similar to the roof framing discussed in (b) above (Figure 7, Page 19).

Where the floor joists are spanned between the corridor and exterior walls, the resulting loads may exceed the capacity of the existing framing, particularly that of the exterior walls. It will then become necessary to provide additional framing to support the new roof, or roof and floor as the case may be. Figure 7 (Page 19) and Figure 8 (Page 20) illustrate possible solutions of this problem. It is assumed that the corridor partitions are capable of supporting the added floor. The new roof is clear-spanned across the building. Wood trusses of the required span are most readily available with pitched top chords, though other configurations may be used. At the exterior walls, the roof trusses (and the floor members, if required) are supported by glulam or built-up wood beams, depending on the span selected. The beams in turn are supported by columns (built-up wood, glulam or hollow structural sections) extending to the top of the foundation wall. Lateral support for



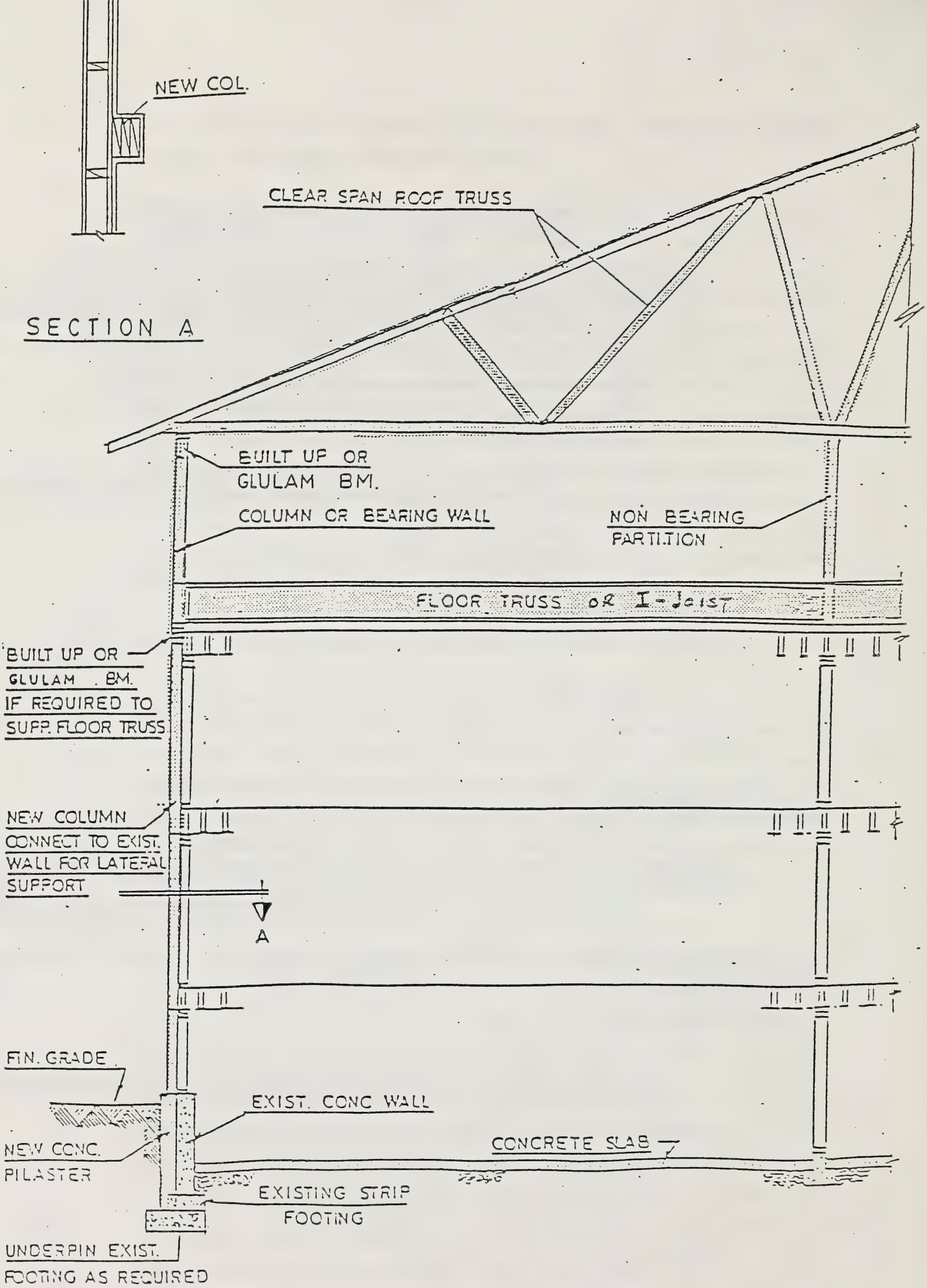
NEW FLOOR JOISTS PARALLEL TO EXISTING FRAMING



NEW FLOOR FRAMING PERPENDICULAR TO EXISTING FRAMING

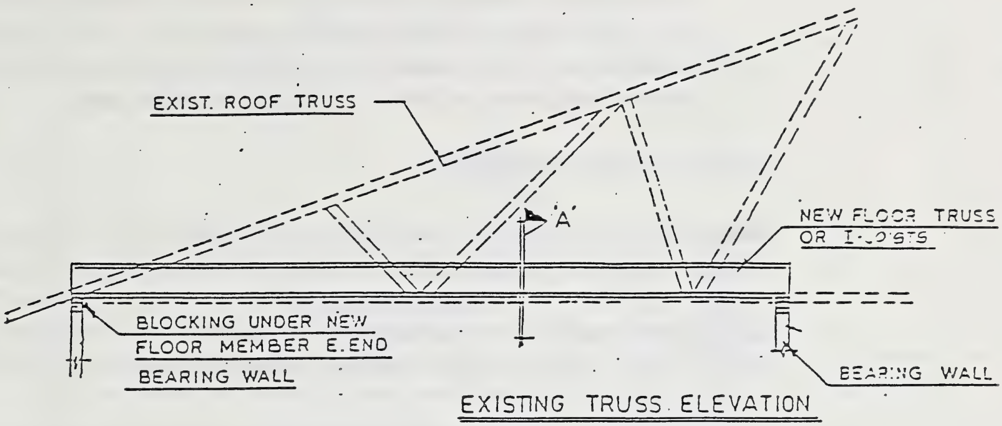
NEW FLOOR OVER EXISTING ROOF JOISTS

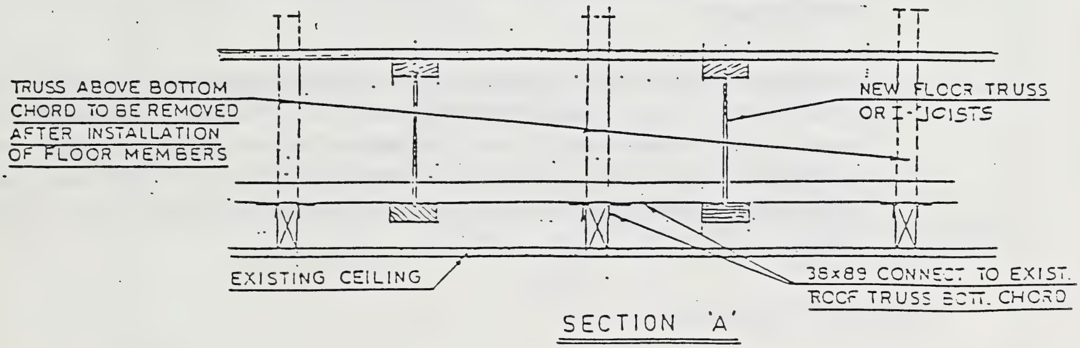
FIGURE # 7



TYPICAL BUILDING CROSS-SECTION

FIGURE # 8





FLOOR FRAMING TO REPLACE EXISTING
ROOF TRUSS

FIGURE # 9

the columns is obtained by connecting to the existing framing. This reduces the size of the columns to their minimum practical size. The columns can be supported on concrete pilasters at the existing foundation wall, and the existing footings underpinned, as required, to support the added loads.

.2 Category 2 - Pitched Roof Buildings:

While less common than flat roofed buildings, there are a sufficient number of these buildings in existence to warrant special attention. In this case, the existing roof has to be removed to permit the installation of the new floor. In order to preserve the existing ceilings, light fixtures, etc. it is desirable to leave at least the bottom chords of the existing trusses in place. Figure 9 (Page 21) illustrates one method by which this may be achieved.

Floor framing similar to that discussed under (b) above is installed between the exterior and corridor walls prior to the removal of the existing trusses. Supports for the existing bottom chords are then installed between the floor members, and the remaining members of the trusses are removed.

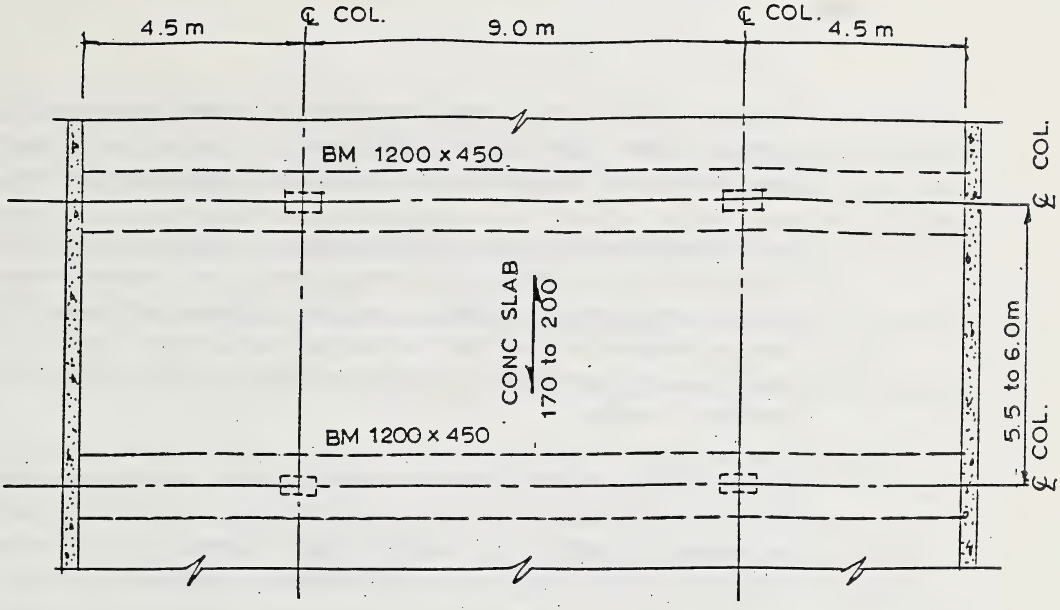
The exterior walls of buildings of this type have supported a roof load from trusses spanning the full width of the building. It is therefore to be assumed that they can support the floor joists spanning from corridor to the exterior walls. If they cannot support the additional loads of the new roof, exterior columns and beams may be added as discussed under (c) above.

It has been assumed that the corridor walls are capable of supporting the framing of the added floor. In the rather unlikely situation where this is not the case, trusses spanning the entire width of the building would have to be used with the likely addition of exterior beams and columns. Such trusses would be of a substantial depth (1200 mm - 48 inches or more) for the spans commonly encountered, and it is unlikely that this would be an economical option.

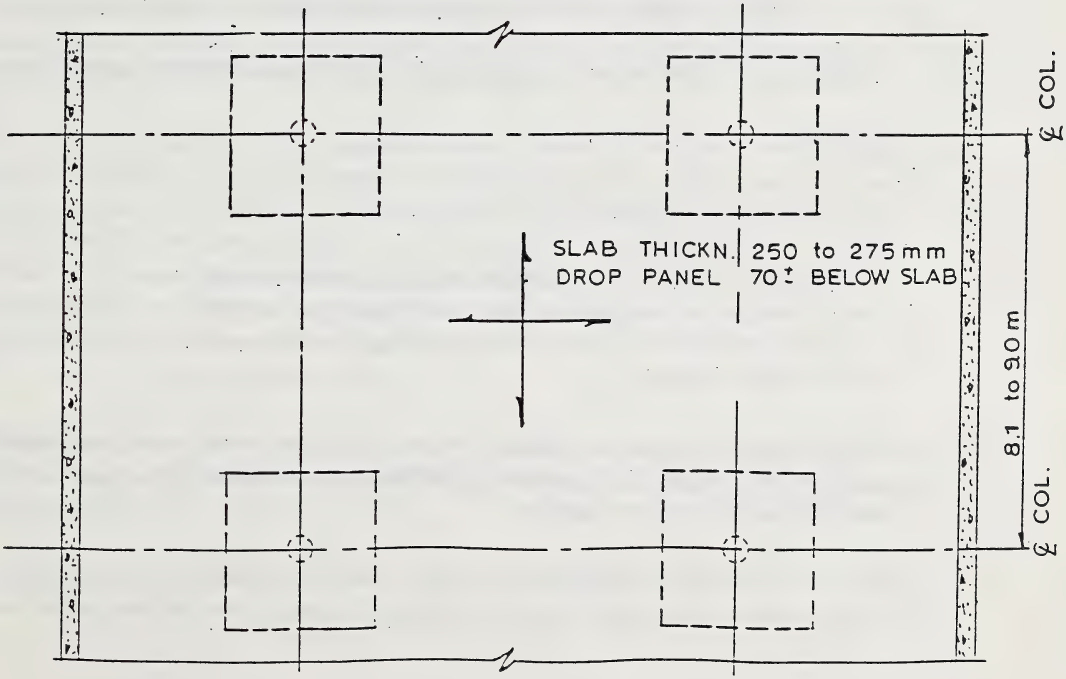
ANCILLARY STRUCTURES

.1 Parkades:

One solution to the provision of additional parking on tight sites is to use simple parking structures. The optimum width for parallel parking is about 18 meters clear, which allows for two rows of parked cars and a central driving aisle. While a clear span of this distance allows the greatest flexibility in parking layouts it results in considerable structural depth and increased structural costs. Commonly the 18 m span is broken down into spans of 4.5 m, 9 m and 4.5 m for greatest ease of parking and to minimize the floor to floor height, thus



BEAM & ONE WAY SLAB



FLAT SLAB WITH DROP PANEL

TYPICAL PARKADE FRAMING PLANS

FIGURE #10

reducing the length of access ramps. Stall widths are generally of the order of 2.7 m with a minimum clear width of 2.6 m between columns. Typical column spacing in the transverse direction should allow a clear width of 2 or 3 stalls between columns.

Because parking garages must be of incombustible construction they are most commonly built in concrete.Spans of the above magnitude permit the use of relatively shallow cast-in-place concrete structures. Flat slabs or wide shallow beams (slab bands) with one-way slabs are frequently used to obtain the minimum structural depth (Figure 10, Page 23). Precast concrete construction has also been used, particularly where larger clear spans are considered desirable.

A few parkades have been built with structural steel framing. However this report focuses on cast-in-place concrete for pricing purposes. Regardless of the system ultimately chosen, the provisions of CAN3-S413-87 should be followed to achieve durable structures and to minimize the problems that have occurred in this type of building.

.2 Amenity Spaces:

As discussed in Section 2.1, amenity spaces can often be provided in the form of roof terraces. An alternative is enlarging existing balconies, but this is generally a very expensive option and should only be considered if no other choice is available, or if one cannot reach an accommodation or requirement waiver with planning officials.

2.3 EVALUATION OF MECHANICAL AND ELECTRICAL SYSTEMS AND OPTIONS FOR EXPANSION

HEATING

The typical walk-up apartment built over 20 years ago is provided with only basic mechanical services. Suites are heated by hot water perimeter radiation in each room. The hot water for the heating system is supplied from a single gas fired boiler located in the basement or main floor. An insuite thermostat automatically regulates the amount of heat supplied to any individual suite. When considering the extension of these existing buildings there are a number of options available for the heating system expansion.

Since the existing heating system has a boiler which is sized to suit the building, this unit can be replaced with a larger unit. This would be particularly appropriate where the existing equipment is approaching the end of its useful life.

The new boiler should have sufficient capacity to heat both the existing and new addition. If this option is adopted, there are a number of additional steps to be taken and items to be investigated.

The circulating pumps for the existing boiler should either be replaced, especially if they are over 20 years old, or new pumps added to serve the addition. Piping from the new boiler must be larger than the original system to allow for the increased capacity and lead to a manifold from which connections can be made to the existing pipe runs and a new set of pipes routed directly to the addition. Owners must investigate the following concerns before taking any action:

a) Is the gas line of sufficient size to service the increased capacity for heating and hot water.

b) Is the existing flue or chimney large enough to serve the new boiler and hot water heaters.

An alternate and potentially less disruptive option is to provide a new boiler for the addition only. Unfortunately, there is generally minimal space within the existing boiler rooms and therefore any new boiler must be housed in a new boiler room. The most economic solution is to have the new boiler room on the new floor. This allows for the new piping distribution and chimney stack to be minimal in length and size. Adequacy of the existing gas service must still be investigated. If necessary it would have to be increased in size from the main to the existing gas meter. Then the only additional concern would be to ensure the existing chimney is extended correctly through the addition.

PLUMBING

Plumbing for the apartments consists of basic bathroom and kitchen facilities. The plumbing fixtures are serviced by hot water from gas fired water heaters within the boiler room, and water, gas and sewer systems provided by City or local utility companies.

Extension to the plumbing system requires a review of the existing water and sewer services. The ability of the plumbing system to adequately meet the demands of the building now and in the future is a function of:

i) the number of plumbing fixtures to be serviced,
ii) the size of existing pipes,
iii) the water service pressure, and
iv) the slope of waste piping.

There are a number of mixes for the above that can provide a satisfactory solution. It is important for any owner to establish the size, slope and pressure for these basic services prior to any decision on expansion.

Generally, the typical apartment has a plumbing stack or drain that rises vertically between a group of bathrooms. The minimum size of this pipe should be 80 mm (3 inches) and this should be sufficient for handling the additional load for the scale of extension being discussed. Any larger size would obviously be adequate also; however, a smaller size would require a professional evaluation.

Drainage from the vertical stacks is collected in a below grade horizontal sewer which delivers the effluent to the City system. The sizing of this line is based on a combination of its load, slope and size. In practically all cases, if this line is 150 mm (6 inches) or greater, it will easily accommodate both the existing and addition to the building. Anything less will require a professional evaluation, with a 100 mm (4 inch) line being acceptable in only a very few situations. Certainly anything less would be unacceptable.

The water service to a building is determined by the load demand and the available pressure in the City system. If the existing water service is adequate to meet the existing building demand, it should also be sufficient for the range of addition being considered. Generally, the following rule of thumb can be applied.

.1 If the available pressure in the City water system is low (140 kPa to 300 kPa) the existing line service should be 50 mm. This will be adequate for a 30% increase in demand as being proposed.

.2 If the available pressure is above 300 kPa, the minimum service line can be a minimum of 40 mm and still accommodate the expansion.

The other plumbing component is the storm water drainage which typically runs from roof drains or a roof gutter system. Depending on the location of the apartment this system will tie into a City storm sewer or will splash onto grade around the building. Either situation should not cause any problems for an addition since there would be minimal increase in the area of the building. The roof area would remain the same, therefore, the existing roof drainage system would merely require extending to the new level. However an owner should check whether the City now requires the building storm drainage system to be connected directly to the City system if there is an addition.

VENTILATION

Ventilation is similar to typical residential dwellings with exhaust fans provided to bathrooms and range hoods within the kitchen. Vertical shafts will have to be extended through the addition.

CHECK LIST

The following summary lists the existing services that must be investigated and is a primary, though not exclusive, list of issues which must be considered:

a) Gas Service:

Is it large enough for the expansion?

b) Water Service:

What is the size of existing service and pressure in the City system? Are there any existing water demand problems?

c) Building Drainage:

What are the sizes of existing vertical and horizontal sewer lines? Identify the size of the building sewer lines plus their slope (if possible).

d) Storm Drainage:

Are there any changes in the City requirements for storm drainage from the date of original building construction?

OTHER SERVICES

If the main electrical service to the building is adequate for the addition, power can be distributed to the new units from a panel located on the third floor.

Stair shafts can be extended to serve the added floor. Some replanning of stairs may be necessary if additional risers are required between the second and third floors.

2.4 MEASURES FOR UPGRADING EXISTING UNITS

Some existing finishes will have to be repaired or replaced due to the investigation and construction process. Additional upgrading may be considered depending on the age of the existing building, condition, location, and rental market. Regardless of the range of the upgrades, they should be costed separately from the addition to assess their impact on the economic viability of the entire scheme.

Items that could be considered include the following:

a) Floor, wall and ceiling finishes:

Some of these will have to be replaced after construction is completed. Additional redecorating, replacement of carpets and other floor coverings, bathroom finishes and light fixtures may be considered, as essential maintenance or to upgrade the rental value of the units. Upgraded finishes in entrance and circulation spaces could help in marketing the new units.

b) Upgrading of exterior walls:

In many older buildings, existing wall insulation is below current standards. A common method of increasing the insulation is to add a layer of rigid insulation to the exterior of the building before applying a new finish. This method could be used to conceal exterior columns as shown on Figure 7 (Page 19) and to obtain a uniform exterior finish over the entire building surface. From an energy conservation standpoint, it might be desirable to replace existing windows and patio doors. The cost, however, is likely to be high in comparison with savings that can be realized.

c) Landscaping, walkways, amenity areas:

Some of these items may suffer damage due to construction, or relocation of parking or existing services. Careful restoration and upgrading where possible of landscaping and amenities will not only improve relations with adjoining property owners but will probably become a requisite commitment when negotiating with municipal authorities.

2.5 PROTECTION OF EXISTING TENANTS

Any construction work carried out in occupied buildings is going to cause a certain amount of inconvenience and disturbance to the occupants. The objective should be to minimize the disturbance and to make the construction process as acceptable as possible to the existing tenants.

Some of the investigations of existing structural and mechanical systems will require the removal of some existing finishes. (The extent to which finishes are removed will vary but should be sufficient to provide an adequate knowledge of existing conditions.)

The greatest disturbance will be caused to occupants of the existing top floor apartments. Access to these units will be required for the extension of mechanical services. The removal of existing roofing and construction of new units above is bound to cause some noise and discomfort for the occupants directly below.

Temporary weather protection is normally provided by using tarpaulins or polythene sheets. These have to be carefully installed, sealed and maintained to prevent leaks due to sudden rainstorms. In the case of flat roofed buildings an adequate working platform exists for the protection of the occupants and installation of temporary weather protection. In pitched roof buildings, the measures discussed above can be utilized to retain existing ceilings. Additional temporary protection will be required to avoid damage or danger to occupants due to dropped tools, materials, etc., and to provide a temporary enclosure. In some cases, it may be necessary to evacuate areas of the top floor during critical stages of construction.

2.6 ECONOMIC CONSIDERATIONS

The number of variables involved makes it difficult to assign precise costs that can be applied to all situations. Representative ranges of costs were, therefore, developed for various components of the extension which can be combined to assess the overall feasibility of the project.

Due to the large number of factors that must be considered in planning an expansion, economic feasibility must be assessed on a project by project basis. The most important factors are rental rates, vacancy rates, mortgage rates, operating costs and construction costs all of which will vary with time and location. While representative examples for these costs have been selected for a particular time (late 1990) and location (Edmonton) they are only used to suggest ranges of values. The following analysis is not intended to speak to the overall success or failure of the concept. Most importantly, this example illustrates the process which must be applied to any potential expansion project. It is not a definitive pro-forma analysis, but a guide for the reader's consideration.

a) Rental Rates:

Rents fluctuate not only with time and between urban centres, but also between localities within an urban area. Statistics published by CMHC for the Edmonton Metropolitan Area show a decrease in average apartment rents for the period April 1982 to 1985, relatively stable rates for the period April 1985 to April 1987, and increasing rents for the period April 1987 to April 1990, with the largest increases, of the order of 6%, occurring between April 1989 and April 1990. The increase in rents between April 1990 and October 1990 was about 3%. Further increases of a similar magnitude are predicted for the beginning of 1991. In October 1990 representative ranges of apartment rents in metropolitan Edmonton were:

Apartment Size	Rent	Average
1 Bedroom Apartments	\$360 - \$470 per month	\$415
2 Bedroom Apartments	\$435 - \$595 per month	\$515
3 Bedroom Apartments	\$460 - \$680 per month	\$570
Underground Parking Stalls	\$30 - \$35 per month	

It should be noted that current rents in Edmonton are considerably below those required to finance any new construction of almost all types of apartment buildings. Studies suggest that "market rents" are approximately $180 per month below the requisite "economic rents". The economic rents in a new low-rise building would be in the following areas: one bedroom $640, two bedroom $710 and three bedroom $780. This discrepancy must be held in mind by anyone contemplating expansion of their rental holdings.

b) Vacancy Rates:

Vacancy rates in the Edmonton metropolitan area have declined since 1986. In October 1990, depending on the location and size of units, vacancy rates varied from a low of 0.3% to a high of 3.7% within the area.

c) Operating Costs:

Current operating costs range from $2,100 to $2,500 per suite per year. The goods and services tax has increased operating costs as they are not eligible for input tax credits.

d) Mortgage Rates:

The high interest rates that prevailed in most of 1990 were a serious impediment to investment, particularly to construction where the cost of borrowed funds is generally the largest ongoing expense. Mortgage rates in 1990 were in the 13% to 14% range, a level that would make many projects uneconomical. Rates began to decline at the end of 1990 and further decreases are anticipated in 1991. In recent years the lowest available rates have been in the 10% to 10½% range, and this has been taken as the lower boundary in calculating the economic feasibility of a given project.

e) Construction Costs:

Construction costs for this type of expansion will be much more variable than for new buildings, due to the many site specific factors involved. Only a general range of costs can be given here, and more detailed estimates, including the costs of the required investigations and design, should be obtained for each project at the earliest possible stage. For the purpose of sample calculations, the following range of costs obtained from contractors in the Edmonton area will be used:

Basic addition on existing flat-roofed building:	$375-$500/m^2
If new floor structure is required:	$400-$525/m^2
Additions to pitched roof buildings:	$440-$575/m^2

Additional costs for ancillary structures and upgrading:

Balconies:	$120-$170/m²
Parkades:	$4000-$5500/car
Amenity Areas:	$40-$70/m²
Upgrading costs for existing units will vary widely but could be of the order:	$ 50-$150/m²

The sample calculation on Tables 3, 4 and 5 (Pages 32, 33 and 34) applies the upper and lower boundary costs to the example discussed in 2.1, to establish a range of economic options for an extension project.

In the example the cost of providing additional parking with limited associated revenue had an adverse effect on the economic feasibility of the project. In some cases such as larger integrated projects (Plates 17 - 19 - See Appendix) it may be possible to provide additional grade level parking, or additional parking may be available on adjacent sites.

The example appears to confirm that current rents are below the level required to finance new apartment construction in the Edmonton area. Decreasing vacancy rates will tend to raise average rents to the point where new units can be brought onto the market.

TABLE 3 : CONSTRUCTION AND OPERATING COSTS FOR EXTENSION

COSTS	LOWER BOUNDARY		UPPER BOUNDARY		PROPOSED EXTENSION
	Per Unit (M^2)	Total	Per Unit (M^2)	Total	
CONSTRUCTION COSTS: 638 m^2 basic addition on flat-roofed building	$375	$239,250	$500	$319,000	
ADDITIONAL COSTS: Amenity Areas - 190 m^2 on existing roof	$40	$7,600	$70	$13,300	
Balconies for new units - 53 m^2	$120	$6,360	$170	$9,010	
PARKING COSTS: Parkade as in Figure 3 - 35 stalls	$4,000	$140,000	$5,500	$192,500	
Total Project Excluding Optional Costs		**$393,210**		**$533,810**	
Mortgage Financing 75%		$294,908		$400,358	
Equity Required		$98,302		$133,452	
Mortgage Financing Cost/Month 25 year Amortization	10%	$2,638	14%	$4,700	
Operating Costs/Month (7 units/12 months)	$2,100	$1,225	$2,500	$1,458	
Total Monthly Costs		**$3,863**		**$6,158**	
Monthly Revenue Required To Produce an Annual Return on Equity Of	**12%**	**$4,846**	**15%**	**$7,826**	

TABLE 4 : CONSTRUCTION AND OPERATING COSTS FOR EXTENSION INCLUDING OPTIONAL CONSTRUCTION

COSTS	LOWER BOUNDRAY		UPPER BOUNDARY		PROPOSED EXTENSION
	Per Unit (M^2)	Total	Per Unit (M^2)	Total	
BASE COST FROM TABLE 3		$393,210		$533,810	
OPTIONAL COSTS: Upgrading of Existing Units 2,496 m^2	$50	$124,800	$150	$374,400	
Total Project Including Optional Costs		**$518,010**		**$908,210**	
Mortgage Financing 75%		$388,508		$681,158	
Equity Required		$129,502		$227,052	
Mortgage Financing Cost/Month 25 year Amortization	10%	$3,475	14%	$7,996	
Operating Costs/Month (7 units/12 months)	$2,100	$1,225	$2,500	$1,458	
Total Monthly Costs		**$4,700**		**$9,454**	
Monthly Revenue Required to Produce an Annual Return on Equity Of	**12%**	**$5,995**	**15%**	**$12,292**	

TABLE 5 : REVENUE PROJECTIONS

REVENUES PER MONTH	LOWER BOUNDARY		UPPER BOUNDARY		PROPOSED EXTENSION
	Per Unit (M^2)	Total	Per Unit (M^2)	Total	
RENTS:					
4 - 2 bedroom units	$435	$1,740	$595	$2,380	
3 - 1 bedroom units	$360	$1,080	$470	$1,410	
		$2,820		$3,790	
Less Vacancy	5%	$140	1%	$40	
Total Rents		$2,680		$3,750	
Parking 16 Stalls	$30	$480	$35	$560	
Total Revenue Without Upgrading Existing Units		**$3,160**		**$4,350**	
Possible Additional Revenue Due to Upgrading of Existing Units:					
18 - 2 bedroom units	$25	$450	$75	$1,350	
11 - 1 bedroom units	$20	$220	$60	$660	
1 - bachelor unit	$10	$10	$30	$30	
Total Due to Upgrading		$680		$2,040	
Total Revenue Including Upgrading of Units		**$3,840**		**$6,390**	

3.0 CONCLUSIONS

The technical problems involved in the upward expansion of existing 2½ storey apartment buildings can be overcome in most cases. A careful review of existing conditions will be required to find the optimum solution.

Land use and zoning requirements are likely to be more difficult to accommodate. Parking, landscaping and amenity space requirements will present the greatest problems, and some negotiations with local authorities may be necessary to resolve them.

The period from 1983 to 1988 saw high vacancy rates and stagnant rents in almost all Alberta centres. Since 1988, vacancy rates have dropped substantially and rents have risen moderately. Current rents are still below the level required to produce an acceptable rate of return on the capital required for new construction. As a result virtually no new apartment construction has taken place in recent years, and vertical extension of existing buildings is not economically feasible.

It is anticipated that, with continued growth in the major urban centres, vacancy rates will fall to the point where new units must be brought onto the market. At the point where rent levels equal capital and operating costs, vertical expansion of 2½ storey walk-up apartment buildings would become feasible.

Under these circumstances the expansion of 2½ storey apartment buildings to 3½ storeys would be a method by which additional rental accommodation can be made available in established areas close to existing services and amenities. These expansions will also afford building owners an opportunity to increase their income holdings without the need to purchase additional property, and the concept should be evaluated from this perspective, for its potential implementation when economic conditions are favourable.

APPENDIX A: Typical Apartment Developments in the Central and Outlying Areas of the City of Edmonton

PLATE 1 - TYPICAL UNITS CENTRAL AREA

PLATE 2 - REAR VIEW OF UNITS

PLATE 3 - CORNER UNIT CENTRAL AREA

PLATE 4 - ROW OF UNITS CENTRAL AREA

PLATE 5 - MINIMUM SIDE YARDS BETWEEN UNITS

PLATE 6 - MINIMUM SIDE YARDS BETWEEN UNITS

PLATE 7 - PARKING AREAS AT LANE

PLATE 8 - PARKING AREAS AT LANE

PLATE 9 - REAR OF BUILDING SITE FULLY UTILIZED FOR PARKING

PLATE 10 - SOME PARKING PROVIDED UNDER BUILDING

PLATE 11 - GREATER SIDEYARDS AT SITE IN OUTER AREA

PLATE 12 - NO LANDSCAPING IN REAR YARD OUTER AREA

PLATE 13 - BUILDING WITHOUT BALCONIES - OUTER AREA

PLATE 14 - SOME REAR YARD LANDSCAPING OUTER AREA

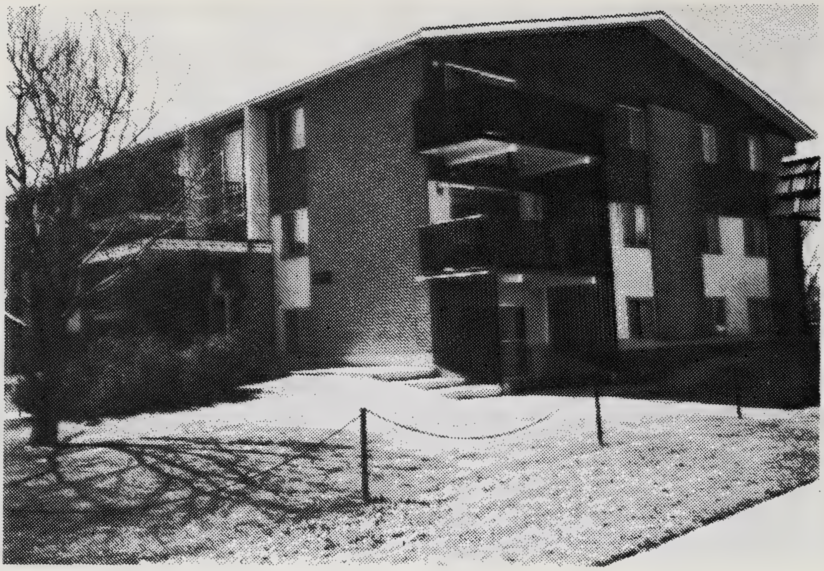


PLATE 15 - FRONT AND SIDE LANDSCAPING OUTER AREA

PLATE 16 - REAR LANDSCAPING OUTER AREA

PLATE 17

LARGE COMPLEX INTEGRATED LANDSCAPING AND PARKING

PLATE 18

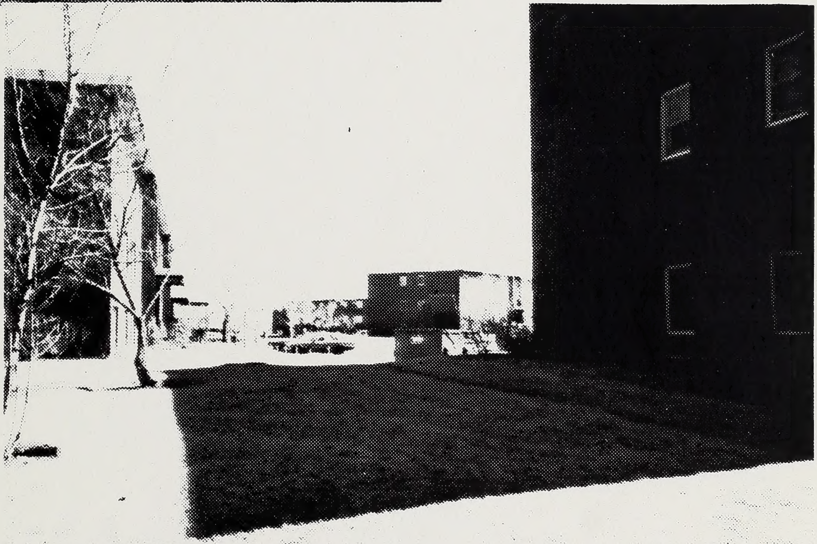


PLATE 19